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physiology in the State University of Oregon Medical College at Portland. The Oregon physiological laboratories are now officered by John D. MacLaren, M.S., M.D., director; L. W. Fetzer, Ph.D., M.D., physiologic chemist; Horace Fenton, A.B., M.D., clinician; Mary V. Madigan, M.D., anesthetist; O. W. Curran, Ph.B., assistant, and J. C. Rinehart, B.S., technician.

#### DISCUSSION AND CORRESPONDENCE

##### ONE PHASE OF WASHINGTON SCIENCE

IN a presidential address<sup>1</sup> before the Geological Society of Washington, Mr. Alfred H. Brooks has reviewed the evolution of applied geology and sought to point out the relation of

the material condition of mankind, the address throws an interesting but perhaps wholly unintended side-light upon one phase of "Washington Science."

The address may be said to constitute both an apology for and a glorification of the almost complete exclusion of pure science from the later work of the United States Geological Survey, and the attempt is further made to show that a like metamorphism has characterized the work of our American universities during the last two decades. The concluding sentences of the address, if taken alone, might indeed seem to contradict the earlier statements of the report. They are worth quoting:

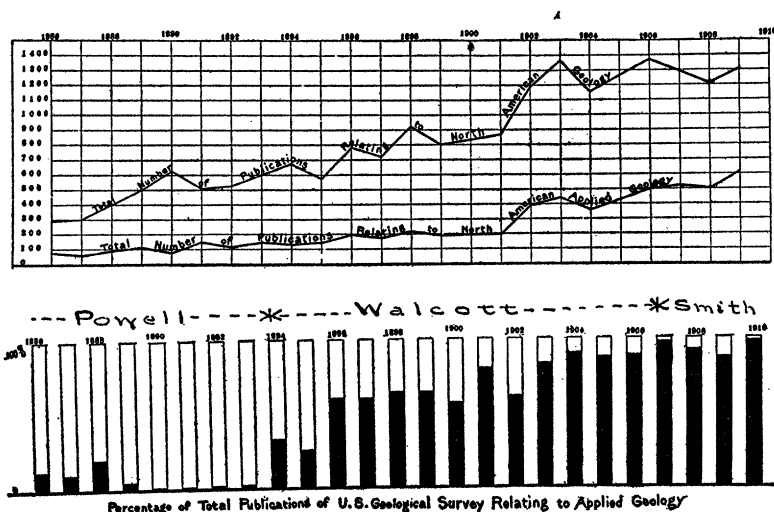


FIG. 1. Diagrams to show by annual increments the number of publications relating to North American geology and applied geology since 1886, and the percentage of total publications of the United States Geological Survey relating to applied geology during the same period.

its advance to that of the science of pure geology, as well as to the evolution of economic, political and social conditions. Though the keynote of the address is made the importance of the scientific investigator having always in view a result which in some way is to improve

There is, however, grave danger that, carried away by the present furor for practical results, we may lose sight of our scientific ideals. Applied geology can only maintain its present high position of usefulness by continuing the researches which advance the knowledge of basic principles.

<sup>1</sup> Alfred H. Brooks, "Applied Geology," presidential address delivered before the Geological Society of Washington, December 13, 1911, *Jour. Washington Acad. Sci.*, Vol. 2, No. 2, January 19, 1912, pp. 14-48.

To his address Brooks has contributed the results of an inquiry to determine what percentage of American geological publications issued during the last quarter of a century has been devoted either wholly or in part

to applied geology. His results are graphically set forth in the upper diagram of the figure. While his method is not above criticism, it probably gives a crude idea of both volume and scope of American geological publications in recent years. It is based upon a count of publications listed in the annual survey bibliography of North American Geology, the papers in pure and applied geology being separated on the basis of their titles. By the same method, a separate count was made of the publications of the U. S. Geological Survey with results reproduced in the lower diagram of the figure. Upon this diagram the reviewer has indicated the periods of the Powell, Walcott and Smith administrations of the survey, since these appear to be not without significance. This diagram shows that although in 1890 less than 1 per cent. of the publications issued by the federal survey treated either wholly or in part of applied geology, no less than 98 per cent. of those issued in 1910 were in this field. Probably the real change is somewhat less striking than the figures indicate, since pure science is often included in reports primarily economic, but no one familiar with the recent transformation of the United States Geological Survey will doubt that the figures are essentially correct. A comparison of the upper and lower diagrams furnishes a sufficient refutation of the notion that the universities of the country have degenerated by the same proportion during the period covered by the investigation.

The apology for this state of affairs, which we think every true friend of science must deplore, is made by Mr. Brooks in the following terms:

If geologic surveys are properly a function of the state, in the last analysis the people must be the final arbiters as to what phase of science is to be emphasized. In our democracy the citizen has the right to inquire what he, as a member of the body politic, is gaining by expenditures from the public purse.

These statements, of course, ignore completely the well-recognized fact that in the long run the greatest material gains have come through basic studies in pure science

and not from "hand-to-mouth" investigations which have always a definite economic end in view; as they do also the further fact that the people are not expert geologists and expect to be advised by those who are and who are employed by them. Most geologists will admit that studies in applied geology were near the close of the Powell administration somewhat too largely subordinated to larger and more fundamental investigations, and that this had much to do with the temporary setback which the survey then received; but in this there is no justification for the almost complete neglect of work in pure science which has been characteristic of later administrations. No one doubts that an entire surrender to the politician clamoring for quick returns makes the securing of survey appropriations comparatively easy, but it should not be concluded from this that the present tendency in the survey is approved by the people of the United States.

Mr. Brooks ventures the opinion that "one reason why the investigators of this continent have accomplished so much for the advancement of geology is that their research has never been entirely divorced from the field of applied science." The reviewer would venture the opinion, and the facts seem to support it, that the great era of American geology was already passing as the craze for investigations in applied geology was gathering headway. Mr. Brooks's further statement that "advances in pure science were always in more or less direct proportion to advances made in the applied sciences," would be much improved by transposing "pure science" and "applied science." We doubt the truth of the statement that "science has made most rapid strides at those times when its study was inspired by desire to achieve some practical end." The declaration that geologic research "has for its aims the application of scientific principles to the needs of man" should be prefaced by the statement, "As interpreted by the United States Geological Survey." In many quarters, we believe, its aim is still quite as much the discovery of scientific principles as their adap-

tation to the needs of man. "We are now," says Mr. Brooks, "applying science to the affairs of the nation as never before. The old-fashioned publicist with his classical education, or, at least, traditions, is being shouldered out of the way by the man who analyzes the problems of public welfare on scientific principles. . . . Yet there are not a few geologists, though I believe a constantly decreasing number, who seem to view with suspicion any attempt to make the science of geology more useful." We believe comment upon these statements would be altogether superfluous.

WM. H. HOBBS

UNIVERSITY OF MICHIGAN,

June 4, 1912

#### PREPARATION OF WHOLE POLLEN MOTHER CELLS

TO THE EDITOR OF SCIENCE: The brief article by Albert Mann on the preparation of whole pollen mother cells for the examination of mitotic figures, in SCIENCE for August 2, suggested that others might be interested in some experiments made along the same line by the writer during the winter of 1911-12. The technical difficulties presented by the method worked out at that time are somewhat greater than in that suggested by Mann, but the results were, on the whole, quite satisfactory.

Whole anthers, which from previous examination were known to represent the stages wanted, were fixed for 30 hours in strong chrome-acetic acid. They were then carefully washed in running water for 24 to 30 hours and gradually run up to 80 per cent. alcohol, in which they were allowed to harden for several weeks. They were then stained for 3 to 5 days in a strong cochineal tincture or in Kleinenberg's hematoxylin. The stains were rinsed off with 80 per cent. alcohol. The specimens were further dehydrated, and after resting in absolute alcohol for 6 to 8 hours were put into a mixture of equal parts of absolute alcohol and cedar oil in an open vial or small cylinder. They were allowed to remain in the open vessel on the paraffin oven until the alcohol had completely evaporated, requiring 2 to 3 days. Finally specimens were carefully dissected or teased apart in a drop of

oil on a slide, and mounted by the addition of a drop of cedar-oil-balsam and a cover.

The important points are the hardening of cell walls before staining, the use of 70 per cent. alcoholic stains which do not overstain, and the gradual transfer from dehydrating to clearing and mounting medium, thus avoiding shrinkage of delicate cells. To any one acquainted with the two classes of stains the advantage of one which does not overstain to one which must be washed out for differentiation is well known, when dealing with mass staining. In trying out Mann's suggestions the writer found difficulty in preventing collapse of cells and in getting uniform results from the stains. The triple stain is especially difficult to manage in mass staining, and although a solution of Orange G. in clove oil, which gives the very best results with sections, was used, only a small portion of the material gave really satisfactory results.

Some of the stains used by the writer are new and the formulæ are given here for those who may care to try them.

*Cochineal Tincture, Ammonia-acetate.*—Digest 5 g. powdered cochineal with 150 c.c. 70 per cent. alcohol and 3 c.c. of glacial acetic acid at a temperature of 60-70° C. for 5 to 8 hours. Add ammonia until solution is neutral or but slightly acid and digest for 4 or 5 hours as before. Cool and filter until clear. Transfer to stain from 70 per cent. or 80 per cent. alcohol and rinse off excess with the same.

This solution does not overstain, and with material fixed in chrome-acetic acid stains chromatin lavender to violet and protoplasm a very light pink. In preparing fern prothallia for whole mounts the writer has found this to stain sperms and egg cells a violet tint with cell walls rose color.

For preliminary examination of pollen mother cells the old acetic-methyl green (5 per cent. to 10 per cent. glacial acetic acid added to a half saturated solution of methyl green in water) is the most generally useful, but it is of little value where gelatinous or slimy sap is present. For such cases the writer has found the following solution of